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Incidence of Hepatic Fibrosis in a Cross-Sectional Population Study in Arunachal Pradesh: A FibroScan-Based Evaluation in a High Hepatocellular Carcinoma Burden Region

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Abstract

Introduction: Arunachal Pradesh has been reported to have one of the highest incidences of hepatocellular carcinoma (HCC) in India. Chronic liver disease and progressive hepatic fibrosis are key precursors of HCC. Early detection of fibrosis using non-invasive methods such as transient elastography (FibroScan) can help in risk stratification and prevention of HCC. This study aimed to determine the incidence and severity of hepatic fibrosis in a community population of Arunachal Pradesh. ***Materials and Methods:*** A cross-sectional study was conducted among 289 participants who underwent FibroScan evaluation. Demographic details, steatosis levels, and liver stiffness measurements were recorded. Fibrosis was graded according to standard kPa cut-offs. Data were analyzed using descriptive statistics. ***Results:*** Among 277 valid participants, 75.81% had minimal fibrosis (F0-F1), while 13.36%, 4.33%, and 6.50% had significant fibrosis stages F2, F3, and F4 respectively. Advanced fibrosis was more common among males and individuals with higher steatosis grades. ***Conclusion:*** The study demonstrates a notable burden of significant hepatic fibrosis in Arunachal Pradesh, highlighting the need for early screening programs in high-risk populations to reduce HCC incidence.

Keywords: Hepatic fibrosis, FibroScan, Hepatocellular carcinoma, Arunachal Pradesh, Liver stiffness, Steatosis

INTRODUCTION

Hepatocellular carcinoma (HCC) represents one of the leading causes of cancer-related mortality worldwide and constitutes the most common primary liver malignancy. India demonstrates regional variation in HCC incidence, with Arunachal Pradesh reporting one of the highest prevalence rates in the country[1]. The increased incidence has been attributed to multiple etiological factors including chronic viral hepatitis, alcohol consumption, metabolic syndrome, and environmental influences[2].

Hepatic fibrosis is a progressive pathological process characterized by excessive extracellular matrix deposition within liver parenchyma, ultimately leading to cirrhosis and HCC[3]. Fibrosis progression often remains asymptomatic until advanced stages, emphasizing the importance of early detection and surveillance[4]. Traditional diagnostic modalities such as liver biopsy remain the gold standard but have limitations including invasiveness, sampling error, and procedural risks[5].

Transient elastography, commonly known as FibroScan, has emerged as a reliable, non-invasive, and reproducible tool for assessment of liver fibrosis. It measures liver stiffness in kilopascals (kPa) and allows simultaneous evaluation of steatosis through controlled attenuation parameter (CAP) measurements[6]. Several global studies have validated FibroScan as an effective screening modality in population-based studies[7].

The burden of chronic liver disease in Northeast India is influenced by unique cultural, dietary, and genetic factors. High prevalence of hepatitis B infection and alcohol consumption have been identified as key contributors to liver disease in this region[8]. Despite this, limited community-based data exist regarding fibrosis prevalence in Arunachal Pradesh.

Population screening using non-invasive techniques is essential for identifying individuals at risk of progressive liver disease. Early detection allows implementation of preventive strategies including

antiviral therapy, lifestyle modification, and surveillance for malignant transformation[9].

Previous studies from high HCC incidence regions have demonstrated a strong association between advanced fibrosis and increased risk of hepatocellular carcinoma[10]. Therefore, understanding fibrosis prevalence in high-risk populations may help develop targeted screening and intervention programs.

The present study was conducted to evaluate the incidence and severity of hepatic fibrosis using FibroScan in a cross-sectional population from Arunachal Pradesh, a region with high HCC prevalence. Additionally, the study aimed to analyze the relationship between fibrosis severity and steatosis levels.

MATERIALS AND METHODS

This cross-sectional observational study was conducted in Arunachal Pradesh between July 2025 and December 2025.

Study Population

Participants included individuals attending health screening camps and hospital outpatient departments who consented to undergo FibroScan evaluation.

Sample Size

A total of 289 individuals were screened during the study period.

Data Collection

Demographic details including age and gender were recorded. FibroScan was performed using transient elastography to measure liver stiffness and steatosis levels.

Fibrosis Assessment

Fibrosis was categorized based on liver stiffness measurement:

- F0-F1: <7 kPa
- F2: 7–9.5 kPa
- F3: 9.6–12.5 kPa
- F4: >12.5 kPa

Steatosis Assessment

CAP values were used to categorize fatty liver:

- S0: <238 dB/m
- S1: 238–259 dB/m
- S2: 260–290 dB/m
- S3: >290 dB/m

Inclusion Criteria

- Adults aged above 18 years
- Individuals willing to participate
- Subjects undergoing FibroScan screening

Exclusion Criteria

- Patients with known cirrhosis under treatment
- Individuals with ascites
- Pregnant women
- Incomplete FibroScan data

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using SPSS version 25. Categorical variables were expressed as percentages. Associations between fibrosis stage, gender, and steatosis were analyzed using descriptive analysis.

RESULTS

Table 1: Demographic Distribution

Variable	Frequency	Percentage
Male	129	46.57%
Female	148	53.43%
Total	277	100%

Table 1 shows the gender distribution of participants included in the study population. Out of the total 277 valid subjects who underwent FibroScan evaluation, 129 participants (46.57%) were males and 148 participants (53.43%) were females.

Table 2: Age Distribution

Age Group	Frequency
<20	10
21-30	70
31-40	81
41-50	50
51-60	29
>60	4

Table 2 presents the age-wise distribution of participants was observed in the 31–40 years age group (81 individuals), followed by the 21–30 years age group (70 individuals). The 41–50 years age group included 50 participants, showing a

gradual decline in participation with increasing age. The 51–60 years group consisted of 29 individuals, while only 4 participants were above 60 years of age. A small number of participants (10 individuals) were below 20 years of age.

Table 3: Distribution of Fibrosis Stages

Stage	Frequency	Percentage
F0-F1	210	75.81%
F2	37	13.36%
F3	12	4.33%
F4	18	6.50%

In the present study, the majority of participants (210 individuals, 75.81%) were classified under F0–F1 stage, which represents either no fibrosis or minimal fibrosis. A total of 37 participants (13.36%) were categorized under F2 stage, which represents moderate fibrosis. Further progression of fibrosis was observed in 12 participants (4.33%) who were categorized under F3 stage, indicating severe fibrosis. Additionally, 18 participants (6.50%) were classified under F4 stage, which corresponds to cirrhosis. Overall, approximately 24.19% of participants in this study demonstrated clinically significant fibrosis (≥F2), highlighting a considerable burden of chronic liver disease in the population.

Table 4: Fibrosis Stage by Gender

Gender	F0-F1	F2	F3	F4
Male	91	23	6	9
Female	119	14	6	9

Table 4 demonstrates the distribution of hepatic fibrosis stages among male and female participants. Among male participants, 91 individuals were classified under F0–F1 stage, indicating minimal or no fibrosis. Moderate fibrosis (F2) was observed in 23 males, while 6 males showed severe fibrosis (F3). Cirrhosis (F4) was identified in 9 male participants. Among female participants, 119 individuals were classified under F0–F1 stage, representing minimal or absent fibrosis. Moderate fibrosis (F2) was observed in 14 females, while severe fibrosis (F3) was seen in 6 females. Cirrhosis (F4) was also observed in 9 female participants. When comparing both genders, males showed a relatively higher frequency of moderate fibrosis (F2) compared to females.

Table 5: Steatosis Grade Distribution

Grade	Frequency
S0	157
S1	42
S2	44
S3	33

Table 5 presents the 157 participants were categorized under S0 grade, indicating absence of fatty liver. A total of 42 participants were classified under S1 grade, representing mild steatosis. Moderate steatosis (S2) was observed in 44 participants. Severe steatosis (S3) was identified in 33 participants, representing advanced fatty liver involvement. Overall, nearly 43% of the study population demonstrated varying degrees of fatty liver (S1–S3).

Table 6: Relationship Between Steatosis and Fibrosis

Steatosis	F0-F1	F2	F3	F4
S0	130	16	4	7
S1	29	6	1	6
S2	33	7	2	2
S3	18	8	4	3

Table 6 demonstrates the among participants with no steatosis (S0), the majority (130 individuals) were classified under F0–F1 stage, indicating minimal or no fibrosis. However, a smaller proportion still demonstrated moderate fibrosis (16 individuals), severe fibrosis (4 individuals), and cirrhosis (7 individuals). In participants with mild steatosis (S1), 29 individuals were classified under F0–F1 stage, while 6 individuals each were observed in F2 and F4 stages, and 1 participant showed F3 stage fibrosis. Among those with moderate steatosis (S2), 33 participants were in F0–F1 stage, while 7, 2, and 2 participants were categorized under F2, F3, and F4 stages respectively. Participants with severe steatosis (S3) showed comparatively higher frequencies of advanced fibrosis. Only 18 individuals were in F0–F1 stage, while 8 participants had F2 fibrosis, 4 participants had F3 fibrosis, and 3 participants were categorized under cirrhosis (F4).

DISCUSSION

The present study evaluated hepatic fibrosis incidence in Arunachal Pradesh, a region known for high HCC

prevalence. The findings demonstrate that 24.19% of individuals had significant fibrosis, highlighting the public health burden of chronic liver disease.

Similar studies have reported fibrosis prevalence ranging between 15–30% in high-risk populations[11]. The higher prevalence in the current study may reflect regional factors including viral hepatitis and alcohol use. Studies from Northeast India have documented higher hepatitis B seropositivity, which significantly contributes to chronic liver disease[12].

In our study, out of the total 277 valid subjects who underwent FibroScan evaluation, 129 participants (46.57%) were males and 148 participants (53.43%) were females. Male predominance in moderate fibrosis stages aligns with previous research indicating higher alcohol consumption among males[13]. Lifestyle factors and occupational exposures may also contribute to this difference.

In current study, the 157 participants were categorized under S0 grade, indicating absence of fatty liver. A total of 42 participants were classified under S1 grade, representing mild steatosis. Moderate steatosis (S2) was observed in 44 participants. Severe steatosis (S3) was identified in 33 participants, representing advanced fatty liver involvement. Overall, nearly 43% of the study population demonstrated varying degrees of fatty liver (S1–S3).

The association between steatosis and fibrosis progression observed in this study is consistent with literature demonstrating that metabolic dysfunction and fatty liver disease accelerate fibrotic changes[14]. Non-alcoholic fatty liver disease is emerging as a major contributor to chronic liver disease globally[15].

FibroScan has proven to be an effective tool for community-level fibrosis screening. Its non-invasive nature and reproducibility make it suitable for large population studies[16]. Studies have shown high sensitivity and specificity of FibroScan in detecting advanced fibrosis[17].

The high prevalence of advanced fibrosis (F3-F4) in this study is clinically significant as these stages are strongly associated with HCC development[18]. Early detection allows targeted surveillance using imaging and tumor marker monitoring.

Public health interventions focusing on viral hepatitis vaccination, alcohol moderation, and metabolic disease control are crucial in reducing liver disease burden. Screening programs using transient elastography may help identify high-risk individuals.

Limitations of the study include absence of viral marker correlation and reliance on cross-sectional data. Longitudinal studies are needed to assess fibrosis progression.

CONCLUSION

This study highlights a significant burden of hepatic fibrosis in Arunachal Pradesh. Nearly one-fourth of the screened population showed clinically significant fibrosis. The findings emphasize the need for community-based screening programs using FibroScan to reduce the risk of hepatocellular carcinoma through early detection and intervention.

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